

January 25, 2002



23911

PATENT TRADEMARK OFFICE

BOX PCT

Honorable Commissioner of
Patents and Trademarks

Washington, D.C. 20231

Attorney Docket No 614HC/50888

Re: Transmittal Letter to the United States
Designated/Elected Office (DO/EO/US)
Concerning a Filing Under 35 U.S.C. §371

International Application No.: PCT/JP01/04247
International Filing Date: 22 May 2001

Priority date claimed: 26 May 2000
Priority application number: 2000-156925

Inventorship: Hiroshi WATANABE
Koichi SHIBATA
Genroku SUGIYAMA
Toichi HIRATA
Hiroyuki ADACHI
Hideki KOMATSU
Yasushi OCHIAI

Title: COMMUNICATION SYSTEM FOR WORKING MACHINES

Enclosed herewith for entering the national stage in the
United States is the above-referenced international
application.

APPLICANT WISHES THAT THE ANNEXES TO THE INTERNATIONAL
PRELIMINARY EXAMINATION REPORT REPLACE THE APPROPRIATE PAGES
OF THE CLAIMS AS FILED.

1. [X] This is a FIRST submission of items concerning a
filing under 35 U.S.C. §371.
2. [] This is a SECOND or SUBSEQUENT submission
of items concerning a filing under 35
U.S.C. §371.
3. [] This express request to begin national examination
procedures (35 U.S.C. §371(f)) at any time rather
than delay examination until the expiration of the
applicable time limit set in 35 U.S.C. §371(b) and
PCT Articles 22 and 39(1).

INTERNATIONAL APPLN. NO.: PCT/JP01/04247
ATTORNEY DOCKET NO.: 614HC/50888

4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. §371(c)(2))
- a. _____ is transmitted herewith (required only if not transmitted by the International Bureau).
- b. ☒ has been transmitted by the International Bureau
- c. _____ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. §371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3))
- a. _____ are transmitted herewith (required only if not transmitted by the International Bureau)
- b. _____ have been transmitted by the International Bureau
- c. _____ have not been made; however, the time limit for making such amendments has NOT expired
- d. ☒ have not been made and will not be made
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. §371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. §371(c)(4)) is:
- ☒ Attached in the regular manner.
- ☐ NOT included, but deferred under P.L. 97-247.

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10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5))
11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An Assignment of the invention in favor of the following organization is enclosed for recordation. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST Preliminary Amendment.
- ☐ A SECOND or SUBSEQUENT Preliminary Amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items of information:
- ☐ Form PCT/RO/101 Request (in English/in French)
- ☐ Small Entity Declaration Under 37 C.F.R. 1.27
- ☐ Copy of Form PCT/DO/EI/905 (Notification of Missing Requirements)
- ☒ 7 Sheets of Formal Drawings
- ☐ _____ Sheets of Informal Drawings
- ☐ The content of the paper and computer readable copy of the attached Sequence Listing, submitted in accordance with 37 CFR \$1.821(c) and (e), respectively, are the same.
- ☒ Kindly appoint as associate attorneys (if not already a principal attorney) or agents:
- Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; and Jeffrey D. Sanok, Reg. No. 32,169

INTERNATIONAL APPLN. NO.: PCT/JP01/04247
ATTORNEY DOCKET NO.: 614HC/50888

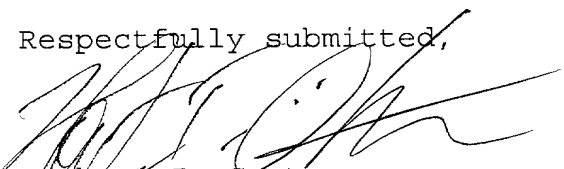
[X] The total amount due for the filing fee in this case
is:

[] Based on Small Entity Status

Total Number of Claims: 8
Total Independent Claims: 1

| | |
|--|---------------|
| Basic filing fee, \$890/\$445. | \$ 890.00 |
| Independent Claims above 3, \$84/\$42 ea. | \$ |
| Total claims in excess of 20, \$18/\$9 ea. | \$ |
| Multiple dependency penalty, \$280/\$140 | \$ |
| Declaration surcharge, \$130/65 | \$ |
| English translation surcharge, \$130 | \$ |
| TOTAL FILING FEE DUE | \$ 890.00 |

Please forward all communications regarding this
application to the undersigned at the letterhead address.

Respectfully submitted,

Herbert I. Cantor
Reg. No. 24,392

HIC/tcv

THE COMMISSIONER IS AUTHORIZED TO CHARGE ANY FEES
WHICH MAY BE REQUIRED OR CREDIT ANY OVERPAYMENT TO
DEPOSIT ACCOUNT NO. 05-1323. THIS FORM IS FILED IN
DUPLICATE.

THIS IS A GENERAL AUTHORIZATION EXCLUDING ONLY
PAYMENT OF THE ISSUE FEE.

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DESCRIPTION**COMMUNICATION SYSTEM FOR WORKING MACHINES****5 Technical Field**

10 This invention relates to a communication system for working machines such as hydraulic excavators, which automatically distributes predetermined information from each of the working machines to its corresponding user station via a control station arranged at a remote location.

Background Art

15 Conventional art of this kind includes, for example, the working machine maintenance system disclosed in JP 7-166582 A. This conventional art features that, when a communication is made from an operator of a working machine to the effect that a trouble has occurred on the working machine, data stored in a controller of the working machine are automatically transmitted to a control station via a communication means such as
20 radiocommunication or a telephone line in accordance with an instruction from the side of the control station.

25 As conventional art different from the foregoing, there is, for example, the machine malfunction monitoring system and method disclosed in JP 11-65645 A. This conventional art features that, when a malfunction is detected during operation

of a machine such as a construction machine, data of the malfunction are automatically transmitted from the machine to a monitoring station at a remote location, in other words, a control station via a communication network.

5 The above-mentioned prior art are each designed such that upon occurrence of a malfunction on a working machine such as a construction machine, data of the malfunction are automatically transmitted to a control station arranged at a remote location. Accordingly, they are effective for repair work of the malfunctioned working machine. These conventional art are, however, intended specifically for the occurrence of a malfunction, and cannot be used for the communication of a message other than the malfunction, such as a desired message corresponding to a given situation, for example, when an urgent contact with a work administration center is desired to report the completion of work or to review a schedule of work in view of the weather or the like or when it is desired to take measures in advance of occurrence of a malfunction.

10

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 According to the above-described prior art, information on a malfunction is sent only to a control station which is managed by the maker of the working machine, and no communication means to a user is referred to. The message relating to the above-mentioned work, however, has to be promptly transmitted to a work administration center, for example, the owner or the like of the working machine rather than the maker.

20

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With the foregoing problem in view, the present invention has as an object the provision of a communication system for working machines, which can communicate messages corresponding to given situations, especially desired messages to respective
5 users from sites, where working machines are arranged, to their corresponding work administration centers at timings as needed by radiocommunication.

Disclosure of the Invention

10 To achieve the above-mentioned object, the present invention is characterized in that in a communication system for working machines, said system comprising controllers arranged on the working machine, respectively, for transmitting predetermined informations from the respective working machines,
15 a control station arranged at a remote location and connected to the controllers via a radiocommunication means such that the predetermined information outputted from each of the controllers is inputted in the control station, and a plurality of user stations connected to the control station via a network, the
20 working machines are each provided with a transmission instructing means for instructing transmission of the corresponding predetermined information; and the control station is provided with an identification means for identifying from the inputted information the corresponding one of the user
25 stations, to which the information is to be transmitted, and

also with a transmission means for transmitting information, which corresponds to the inputted information, to the corresponding user station identified by the identification means.

5 At a stage, for example, that an operator of one of the working machines has operated its transmission instructing means in the present invention constituted as described above, the predetermined information is transmitted from the corresponding controller and is then sent to the control station at the remote
10 location via the radiocommunication means. When the thus-sent information is inputted, the control station identifies the corresponding one of the user stations, to which the information is to be transmitted, in other words, the corresponding specific user station.

15 Information, which corresponds to the inputted information, is then outputted from the transmission means and sent to the corresponding user station via the network.

 According to the present invention, the operator of each working machine can, therefore, send necessary information to
20 the remote location by operating the transmission instructing means as needed. On the other hand, the inputted information is automatically sent by the control station to the corresponding user station, for example, a corresponding work administration center. Accordingly, messages corresponding to situations,
25 especially messages desired by individual users can be

independently communicated from sites, where the machines are arranged, to the corresponding work administration centers at timings as needed via the radiocommunication means.

5 **Brief Description of the Drawings**

FIG. 1 is a schematic diagram showing an overall construction according to a first embodiment of the present invention;

FIG. 2 is a schematic diagram depicting the construction
10 of a communication controller mounted on a hydraulic excavator;

FIG. 3 is a block diagram illustrating the outline construction of a server in the first embodiment of the present invention and a sequence of processing in the server;

FIG. 4 is a flow chart of the sequence of processing in
15 the server as replaced by software-dependent processing;

FIG. 5 is a schematic diagram showing an overall construction according to a second embodiment of the present invention;

FIG. 6 is a block diagram illustrating a sequence of
20 processing by a server in the second embodiment of the present invention; and

FIG. 7 is a block diagram illustrating a sequence of processing by a server in a third embodiment of the present invention.

25 **Best Modes for Carrying Out the Invention**

The embodiments of the communication system according to the present invention for construction machines will hereinafter be described based on the drawings.

As illustrated in the overall construction diagram of FIG. 1, a communication system according to this embodiment for working machines comprises a communication satellite 6, a ground station 2, and a server 1 as a control station, all of which are arranged to send informations, which are transmitted from plural working machines, for example, hydraulic excavators 7, 8, 9, to their corresponding user stations 3, 4, 5. When information is inputted to the server 1 from one of the hydraulic excavators, the server 1 performs processing as will be described subsequently herein, and then sends the information in the form of e-mail to one of the plural user stations 3, 4, 5 connected to the server 1 via a network, said one user station corresponding to the above-mentioned one of the hydraulic excavators. Here, the ground station 2 and the server 1 are connected with each other via a public line, such as a telephone line, or internet 11, while the server 1 and the user stations 3, 4, 5 are connected with each other via an internet 12. As shown in FIG. 2, the hydraulic excavators 7, 8, 9 are each provided with a communication controller 23 and a mail switch 10 as a communication instructing means for instructing transmission of information.

As illustrated in FIG. 3, on the other hand, the server 1 which controls input, output and the like of information sent

from the hydraulic excavators 7,8,9 is provided with a communication receiving unit 13; a terminal user-company identification unit 14 as identification means for identifying, from the inputted informations, user companies of the hydraulic excavators 7,8,9 as user stations to which the informations are to be transmitted, respectively; a user-company-dependent mail selection unit 15 as a selection means for selecting one of mail messages registered corresponding to the individual user companies; a transmission mail creation unit 16 for creating a mail to be transmitted; and a mail transmission unit 17 as a transmitting means for transmitting the thus-created mail. The server 1 is also provided with a terminal information database 18 and a customer information database 19. In the terminal information database 18, the model names, excavator numbers and user companies of the individual hydraulic excavators 7,8,9 are stored in combination as terminal informations 18a,18b,18c. In the customer information database 19, mail addresses and mail texts are stored in combination as customer informations 19a,19b,19c separately depending upon the user companies. The mail texts stored in the customer informations 19a,19b,19c can be set with contents as desired by the individual customers. By way of example, these mail texts are set as "please call a serviceman" for Company A, "please call a tank lorry" for Company B, and "please telephone to my cellular phone" for Company C.

In the first embodiment constructed as described above,

operation of the mail switch 10 by an operator of the hydraulic excavator 7 owned by Company A results in production of information specific to the hydraulic excavator 7, including its excavator number, at the controller 23, followed by the transmission of the information toward the communication satellite 6. The information transmitted from the hydraulic excavator 7 is sent as radio signals to the ground station 2 via the communication satellite 6. From the ground station 2, the information is sent to the server 1 via the public line 11.

In the server 1, it is confirmed at the communication receiving unit 13 whether or not the information has been transmitted to the server 1. --

When the information has been received, the terminal user-company identification unit 14 identifies the corresponding user station, to which the information is to be transmitted, based on the transmitted information. As mentioned above, the information from the hydraulic excavator 7 includes the excavator number as specific identification information. The terminal user-company identification unit 14 reads data corresponding to the excavator number, for example, No. 1 terminal information 18a from the terminal information database 18, and identifies the user company, Company A, which is stored together with the number and model name of the excavator.

After the user company, Company A, has been identified at the terminal user-company identification unit 14, the

user-company-dependent mail selection unit 15 selects the customer information 19a on the use company, Company A, from the customer information database 19.

In the customer information 19a, the mail address of Company A and the mail text "please call a serviceman" are stored. The transmission mail creation unit 16 creates a new message 16a, which contains the model name and number of the hydraulic excavator 7 as a sender, the mail address of Company A as the receiver, the date and time of transmission, and the mail text. As the date and time of transmission, the date and time of receipt of the mail by the server 1 from the hydraulic excavator 7 is desired from the viewpoint of communication cost and the like. As an alternative, the controller 23 may also be designed to produce and output signals indicative of the date and time along with the number of the hydraulic excavator 7 at a stage that the mail switch 10 of the hydraulic excavator 7 has been operated.

Subsequent to the creation of the new message 16a at the transmission mail creation unit 16, the mail transmission unit 17 transmits the mail so that the mail is sent to the user station 3 of Company A via the internet 12. Therefore, the information from the operator of the hydraulic excavator 7 can be immediately read at Company A.

According to the first embodiment, when the operator of any one of the hydraulic excavators 7,8,9 simply operates the mail switch 10 as needed, a new message of predetermined content

is automatically created and is immediately delivered, for example, to the user company of the hydraulic excavator 7, 8 or 9 as described above. At the user company, a measure can hence be taken in response to the communicated information without delay.

In the above-described first embodiment, the individual processing in the server 1 were described to be performed by the correspondingsingle-purposemeans. AsillustratedinFIG. 4, however, these processing may be performed as software-dependent processing. Described specifically, when the server 1 receives the information from the hydraulic excavator 7 in step S1, the received information is read in step S2. In step S3, a user company is identified from the terminal information database 18 on the basis of the information read in step S2. In step S4, a mail text corresponding to the user company is subsequently read from the customer database 19. A newmessageis created in the next step S5, and is then transmitted in step S6.

Based on FIGS. 5 and 6, a description will next be made about the second embodiment of the present invention.

The second embodiment corresponds especially to claim 6.

As shown in the construction diagram of the communication system for working machines in FIG. 5, the hydraulic excavators 7, 8, 9 in the second embodiment are each provided with a position detecting means for receiving signals from GPS satellites

to detect its position. The remaining structure is constructed in a similar way as in the above-described first embodiment.

As illustrated in the block diagram of FIG. 6, when the operator of the hydraulic excavator 7 owned by Company A, for example, operates the mail switch 10 in the second embodiment constructed as described above, the controller 23 reads signals from the GPS satellites 20 and calculates the current position of the hydraulic excavator 7 on the basis of the signals. Information, which includes the excavator number specific to the hydraulic excavator 7 and information on its position, is then produced at the controller 23, and the information is transmitted toward the communication satellite 6.

The server 1 performs substantially the same processing as in the above-described first embodiment. At a transmission mail creation unit 16, however, a new message of such content as including information on the position of the hydraulic excavator 7 is created as shown at a new message 16b.

In addition to the advantageous effect available from the above-described first embodiment, the second embodiment thus allows the user company to determine the current position of the hydraulic excavator 7 from which the information was transmitted, thereby making it possible to take a measure in response to the transmitted information more promptly without delay.

Based on FIG 7, a description will next be made about the

third embodiment of the present invention.

The third embodiment corresponds especially to claim 5.

As shown in the block diagram of FIG. 7, a server 1 in the third embodiment is provided with an internet communication unit 21 and a mail text editing unit 22, both of which are arranged to permit rewriting of the contents of the mail texts described in the customer information database 19 from the side of the user stations 3,4,5. The remaining structure is constructed in a similar way as in the above-described first embodiment.

In the third embodiment constructed as described above, Company B, for example, accesses to the customer information database 19 from the user station 4 via the internet 12, the internet communication unit 21 and the mail text editing unit 22, and reads the customer information 19b on Company B. The mail text editing unit 22 rewrites the mail text from "please call a tank lorry" to, for example, "today's work has been finished", and the mail text of the rewritten content is stored as customer information 19b in the customer information database 19.

In addition to the advantageous effect available from the above-described first embodiment, the third embodiment hence allows each user company to rewrite the mail text into a mail text corresponding to the details of work or the frequency of transmissions of a message, thereby making it possible to efficiently take a measure in response to the communicated

information.

The above embodiments were described by providing each hydraulic excavator as a working machine with one mail switch 10 and storing only one mail text as a mail text to be communicated per user company. However, each hydraulic excavator may be provided, for example, with plural mail switches 10, and mail texts corresponding to the individual mail switches may be stored in the customer information database such that the mail text of the content corresponding to operated one of the mail switches can be sent to the user company.

Further, the informations sent from the hydraulic excavators 7,8,9 as working machines, respectively, were sent to the server 1 via the communication satellite 6. As an alternative, these informations may be sent using ground waves which are employed by cellular telephones and the like.

Industrial Applicability

According to the present invention embodiment, when an operator of any one of working machines simply operates its transmission instructing means as needed, a preset message is sent to the corresponding user company as described above. The user company can, therefore, take a measure in response to the communicated information without delay.

According to the present invention, the user company to which the information has been transmitted can also determine

the current position of the working machine from which the information was transmitted, thereby making it possible to take a measure in response to the communicated information more promptly without delay.

5 According to the present invention, an administration center can rewrite a message as desired corresponding to the details of work or the frequency of transmissions of the message, thereby making it possible to efficiently take a measure in response to the communicated information.

CLAIMS

1. A communication system for working machines, said system comprising:

controllers arranged on said working machine,
5 respectively, for transmitting predetermined informations from said respective working machines,

a control station arranged at a remote location and connected to said controllers via a radiocommunication means such that said predetermined information outputted from each
10 of said controllers is inputted in said control station, and

a plurality of user stations connected to said control station via a network, characterized in that:

said working machines are each provided with a transmission instructing means for instructing transmission of the
15 corresponding predetermined information; and

said control station is provided with an identification means for identifying from said inputted information the corresponding one of said user stations, to which said information is to be transmitted, and also with a transmission
20 means for transmitting information, which corresponds to said inputted information, to said corresponding user station identified by said identification means.

2. The communication system according to claim 1, wherein said predetermined information from each of said working machines
25 includes identification information specific to said working

machine.

3. The communication system according to claim 2, wherein with respect to all the working machines from which informations are sent, said identification informations on said individual
5 working machines are stored corresponding to administration centers of said working machines in a working machine database arranged at said control station.

4. The communication system according to claim 3, wherein said administration centers are each specified by said
10 identification means on a basis of the corresponding identification informations stored in said working machine database.

5. The communication system according to claim 1, wherein said control station has a customer database with transmission
15 texts stored corresponding to said administration centers, and is provided with a selection means for selecting one of said transmission texts, said one transmission text corresponding to said specified administration center, from said customer database.

20 6. The communication system according to claim 5, wherein said specified administration center can rewrite, from the corresponding user station, at least said one transmission text in information stored in said customer database.

7. The communication system according to claim 1, wherein
25 said working machines are each provided with a position detecting

means for detecting a current location of said working machine,
and said predetermined information includes information on said
location.

8. The communication system according to claim 7, wherein
5 said information on said location is included in said information
transmitted from said control station.

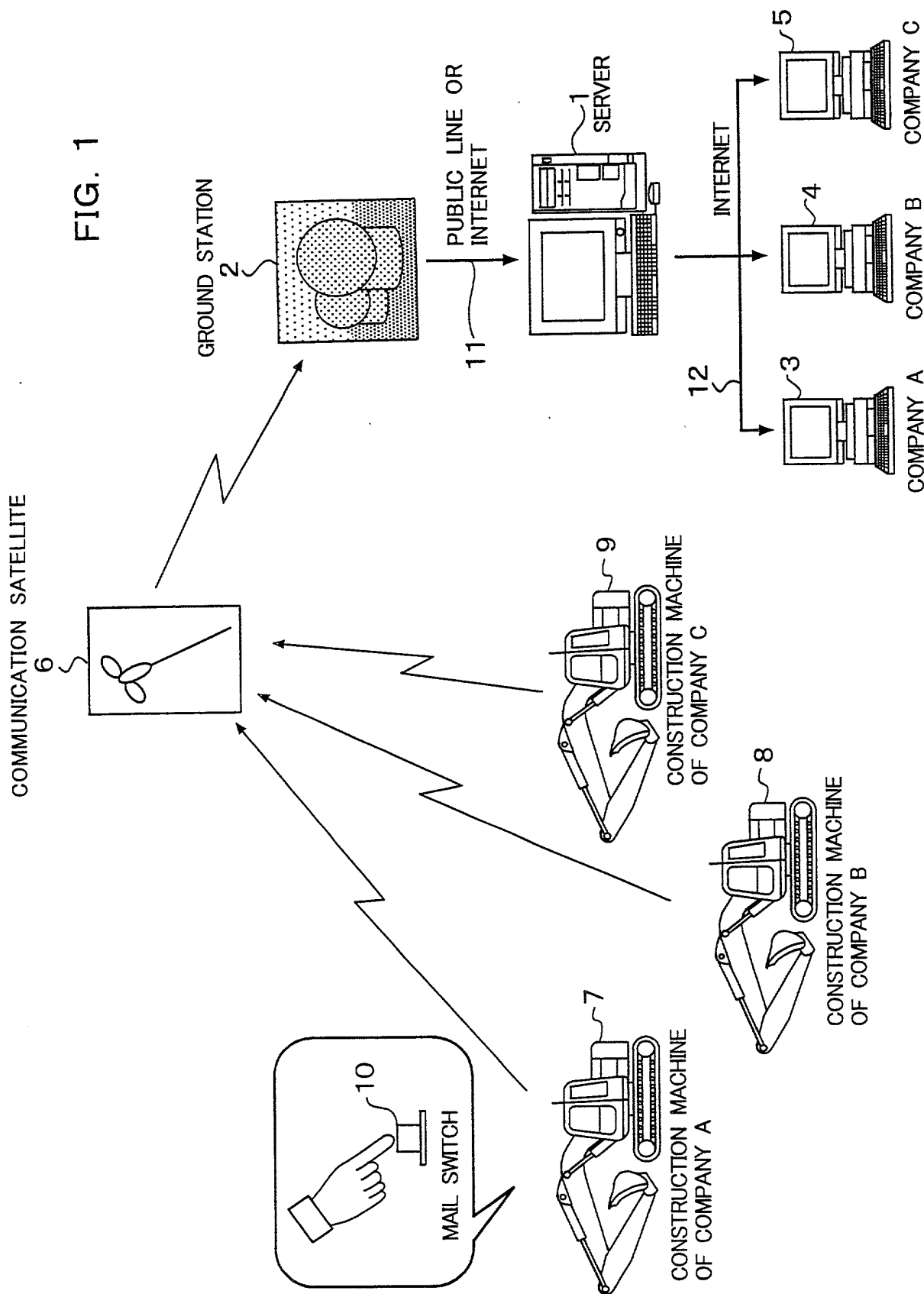


FIG. 2

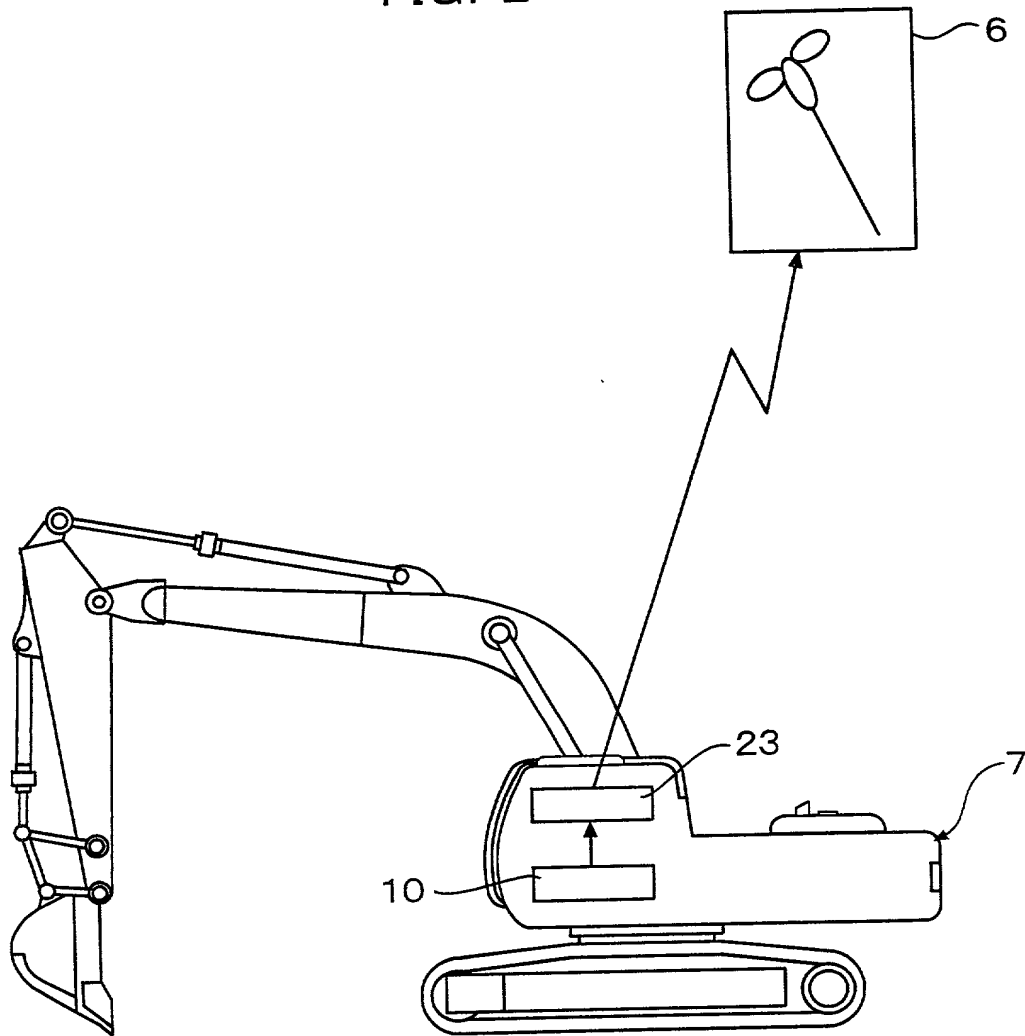


FIG. 3

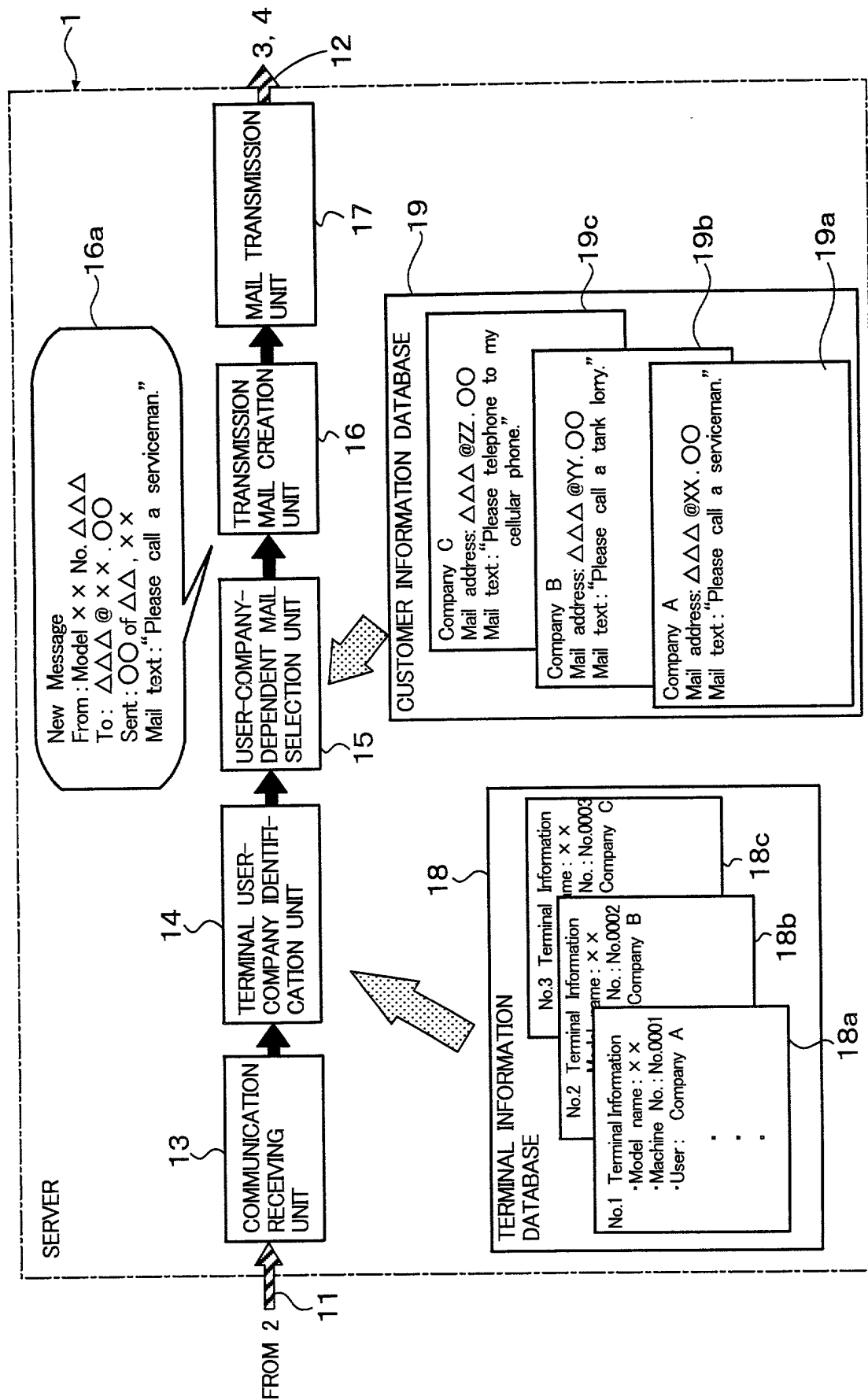
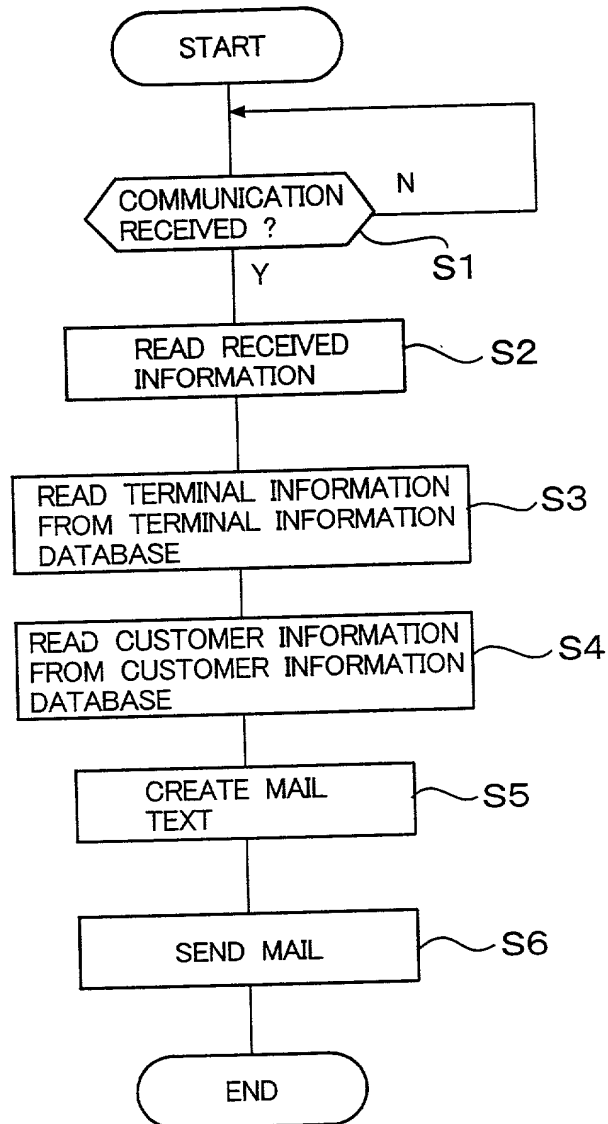


FIG. 4



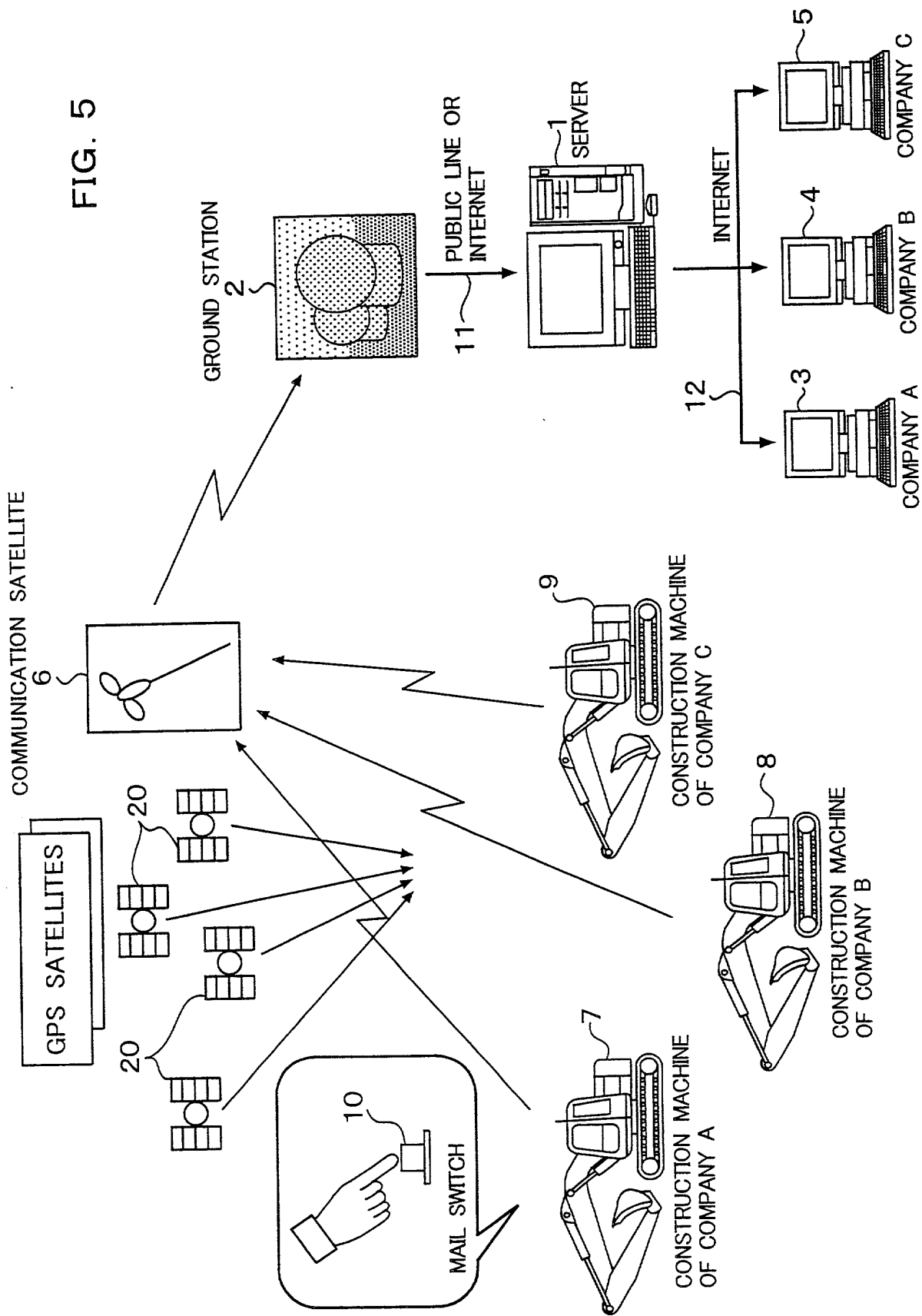


FIG. 6

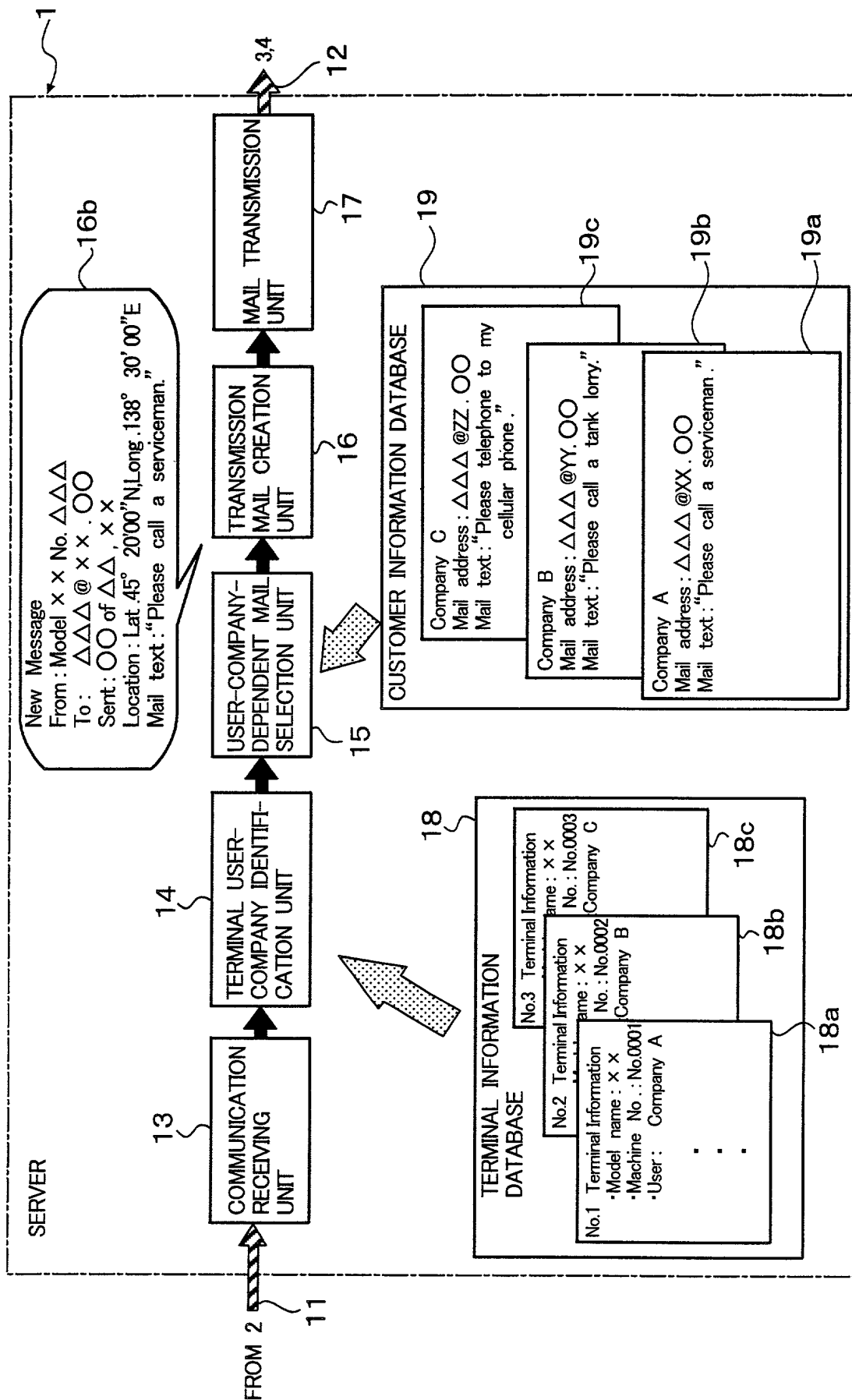
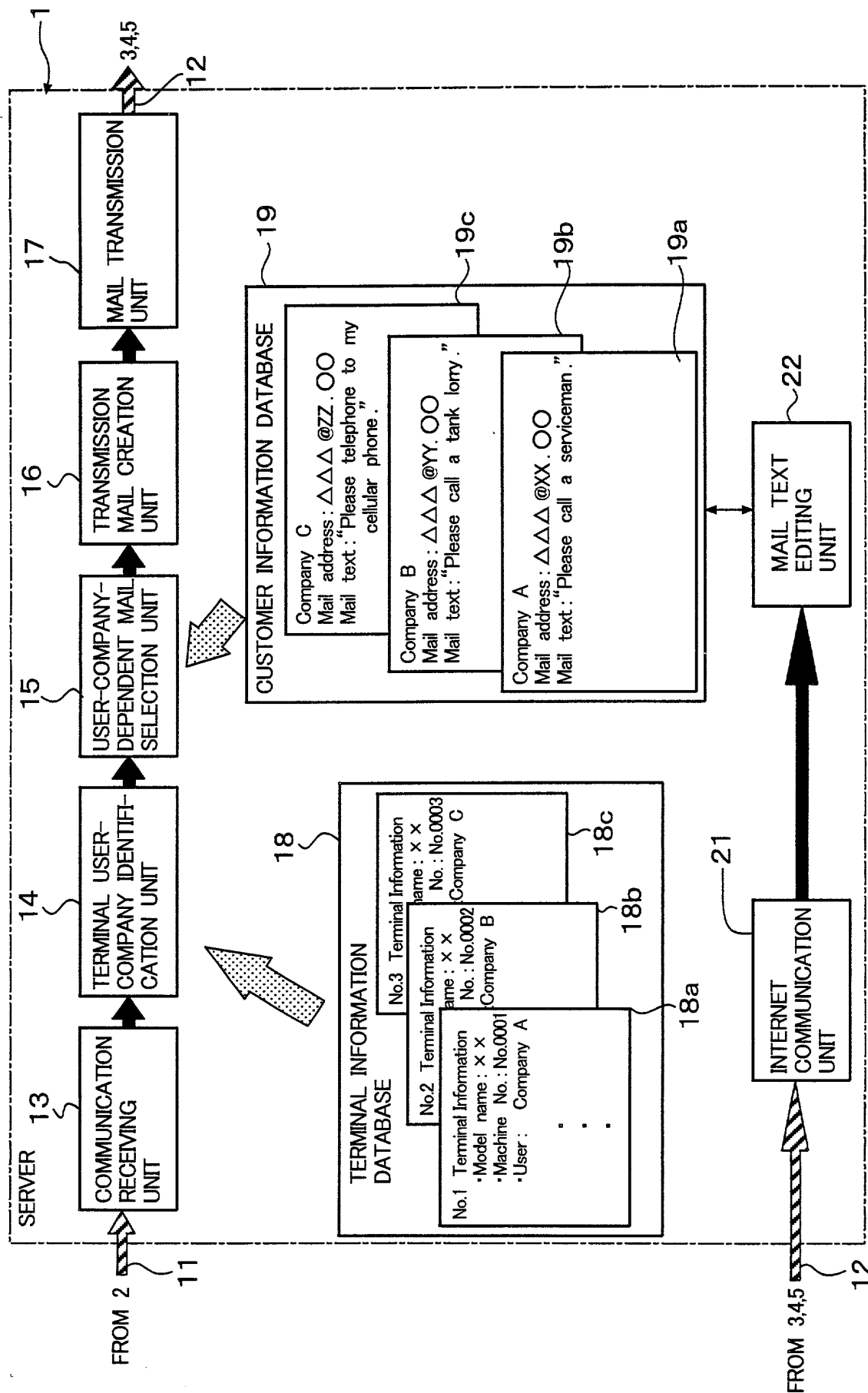


FIG. 7



UTILITY PATENT
OR DESIGN
SOLE OR JOINT

CROWELL & MORING, LLP
UNITED STATES LETTERS PATENT
DECLARATION AND POWER OF ATTORNEY

ATTORNEY'S DOCKET NO.

As a below named inventor, I declare that I believe I am the original, first and sole inventor if only one name is listed at Item 201 below, or a joint inventor if plural names are listed below at Items 201 et. seq. of subject matter which is claimed and for which a patent is sought for the invention entitled:

COMMUNICATION SYSTEM FOR WORKING MACHINES

which is described and claimed in:

101 ☐ the attached specification ☐ the specification in application Serial No. filed
(for declaration not accompanying application papers)

and (if applicable) amended on

102 ☐ international (PCT) application No. PCT/JP01/04247 filed May 22, 2001 and as amended on (if any)

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known by me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim the benefit of priority, under Title 35, United States Code, §119, of any foreign application(s) for patent or inventor's certificate listed in Item 103 below and have also identified in Item 103 below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application for which priority is claimed.

I hereby claim the benefit, under Title 35, United States Code, §120, of any U.S. application(s) listed in Item 105 below. If this application is a continuation-in-part, insofar as the subject matter of any of the claims thereof is not disclosed in the prior U.S. application(s) identified in Item 105 below in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior U.S. application(s) identified in Item 105 below and the national or PCT international filing date of this application.

FOREIGN APPLICATION(S), IF ANY, FILED WITHIN 12 (6 if a Design) MONTHS PRIOR TO THE FILING DATE OF THIS APPLICATION THE PRIORITY OF WHICH WHERE PERMITTED IS HEREBY CLAIMED UNDER 35 U.S.C. §119

| COUNTRY | APPLICATION NUMBER | DATE OF FILING (day, month, year) | PRIORITY CLAIMED | |
|---------|--------------------|--------------------------------------|------------------|----|
| | | | YES | NO |
| Japan | 2000-156925 | 26/05/2000 | X | |

THIS APPLICATION IS A:

☐ CONTINUATION ☐ CONTINUATION-IN-PART
☐ DIVISION OF PRIOR U.S. APPLICATION

SERIAL NO.

FILED

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

JAMES F. MCKEOWN
Registration No. 25,406

HERBERT I. CANTOR
Registration No. 24,392

DONALD D. EVENSON
Registration No. 26,160

JOSEPH D. EVANS
Registration No. 26,269

GARY R. EDWARDS
Registration No. 31,824

JEFFREY D. SANOK
Registration No. 32,169

SEND CORRESPONDENCE TO:

CROWELL & MORING, L.L.P.
P.O. Box 14300
Washington, D.C. 20044-4300

DIRECT TELEPHONE CALLS TO:

202-628-8800

Inventor(s) name must include at least one unabbreviated first or middle name.

| | | | | | | | |
|------------|-----------------------|--|------------------------|------------------|---------|-------------|----------|
| 170 201 | FULL NAME OF INVENTOR | LAST NAME | WATANABE | FIRST NAME | Hiroshi | MIDDLE NAME | |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | Ushiku-shi, Ibaraki | STATE OR COUNTRY | Japan | CITIZENSHIP | Japanese |
| | POST OFFICE ADDRESS | 1082-66, Tagucho, Ushiku-shi, Ibaraki 300-1236 Japan | | | | | |
| 200 202 | FULL NAME OF INVENTOR | LAST NAME | SHIBATA | FIRST NAME | Koichi | MIDDLE NAME | |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | Tsuchiura-shi, Ibaraki | STATE OR COUNTRY | Japan | CITIZENSHIP | Japanese |
| | POST OFFICE ADDRESS | Shihoryo, 2-20-29, Kandatsuchuo, Tsuchiura-shi, Ibaraki 300-0011 Japan | | | | | |
| 300 203 | FULL NAME OF INVENTOR | LAST NAME | SUGIYAMA | FIRST NAME | Genroku | MIDDLE NAME | |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | Inashiki-gun, Ibaraki | STATE OR COUNTRY | Japan | CITIZENSHIP | Japanese |
| | POST OFFICE ADDRESS | 2337, Oyama, Miho-mura, Inashiki-gun, Ibaraki 300-0402 Japan | | | | | |

| | | | | | | | |
|------------|-----------------------|--|------------------------|------------------|----------|-------------|----------|
| 400 204 | FULL NAME OF INVENTOR | LAST NAME | HIRATA | FIRST NAME | Toichi | MIDDLE NAME | |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | Ushiku-shi, Ibaraki | STATE OR COUNTRY | Japan | CITIZENSHIP | Japanese |
| | POST OFFICE ADDRESS | 4-203, Sakaecho, Ushiku-shi, Ibaraki 300-1233 Japan | | | | | |
| 500 205 | FULL NAME OF INVENTOR | LAST NAME | ADACHI | FIRST NAME | Hiroyuki | MIDDLE NAME | |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | Tsuchiura-shi, Ibaraki | STATE OR COUNTRY | Japan | CITIZENSHIP | Japanese |
| | POST OFFICE ADDRESS | 848, Okijukumachi, Tsuchiura-shi, Ibaraki 300-0023 Japan | | | | | |
| 600 206 | FULL NAME OF INVENTOR | LAST NAME | KOMATSU | FIRST NAME | Hideki | MIDDLE NAME | |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | Kitasoma-gun, Ibaraki | STATE OR COUNTRY | Japan | CITIZENSHIP | Japanese |
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[] Seventh (and more) coinventors on page 3

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of any patent issue thereon.

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|---------------------------|-------------------------|---------------------------|-------------------------|---------------------------|-------------------------|
| SIGNATURE OF INVENTOR 201 | <i>Hiroshi Watanabe</i> | SIGNATURE OF INVENTOR 202 | <i>Koichi Shibata</i> | SIGNATURE OF INVENTOR 203 | <i>Genroku Sugiyama</i> |
| DATE | <i>January 10, 2002</i> | DATE | <i>January 10, 2002</i> | DATE | <i>January 10, 2002</i> |
| SIGNATURE OF INVENTOR 204 | <i>Toichi Hirata</i> | SIGNATURE OF INVENTOR 205 | <i>Hiroyuki Adachi</i> | SIGNATURE OF INVENTOR 206 | <i>Hideki Komatsu</i> |
| DATE | <i>January 10, 2002</i> | DATE | <i>January 10, 2002</i> | DATE | <i>January 10, 2002</i> |

Inventor(s) name must include at least one unabbreviated first or middle name.

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| 201 | FULL NAME OF INVENTOR | LAST NAME OCHIAI | FIRST NAME Yasushi | MIDDLE NAME |
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| | POST OFFICE ADDRESS | POST OFFICE ADDRESS | | |
| 203 | FULL NAME OF INVENTOR | LAST NAME | FIRST NAME | MIDDLE NAME |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | STATE OR COUNTRY | CITIZENSHIP |
| | POST OFFICE ADDRESS | POST OFFICE ADDRESS | | |

| | | | | |
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| 204 | FULL NAME OF INVENTOR | LAST NAME | FIRST NAME | MIDDLE NAME |
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| | POST OFFICE ADDRESS | POST OFFICE ADDRESS | | |
| 205 | FULL NAME OF INVENTOR | LAST NAME | FIRST NAME | MIDDLE NAME |
| | RESIDENCE CITIZENSHIP | CITY OR OTHER LOCATION | STATE OR COUNTRY | CITIZENSHIP |
| | POST OFFICE ADDRESS | POST OFFICE ADDRESS | | |
| 206 | FULL NAME OF INVENTOR | LAST NAME | FIRST NAME | MIDDLE NAME |
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| | POST OFFICE ADDRESS | POST OFFICE ADDRESS | | |

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| | | |
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| SIGNATURE OF INVENTOR 201 <i>Yasushi Ochiai</i> | SIGNATURE OF INVENTOR 202 | SIGNATURE OF INVENTOR 203 |
| DATE <i>January 10, 2002</i> | DATE | DATE |
| SIGNATURE OF INVENTOR 204 | SIGNATURE OF INVENTOR 205 | SIGNATURE OF INVENTOR 206 |
| DATE | DATE | DATE |